APPENDIX 4 - MARINE VESSELS

INTRODUCTION

Marine vessel engines contribute to emissions of NOx, HC, CO, PM, and SOx. Emissions from marine vessel engines are generated in California during vessel travel through defined California coastal waters, vessel calls on California ports, as well as from other vessel activities in and near the ports such as fishing, tugboat operations and work boats. Marine vessels present an ideal application for Carl Moyer Program funding because there are several means for significantly reducing their relatively high NOx emission levels. The Carl Moyer Program provides marine vessel owners with incentive funds for voluntarily reducing NOx emissions from marine vessel engines before mandated regulatory controls go into effect.

Below is additional information pertaining to the Marine Category for the South Coast Air Quality Management District's (AQMD's) FY 2003 Carl Moyer Program (CMP). All information in RFP #2004-04 and this Appendix apply. For additional detail regarding this program category, refer to the California Air Resources Board's (CARB's) 2003 Moyer Program Guidelines[1]. In the case of any conflict between CARB guidelines and AQMD criteria, the more stringent criteria will prevail. Also, it is the Applicant's responsibility to check with AQMD's Moyer Program web page for program clarifications, changes and updates. This page may be accessed by clicking the "Clean Air Technologies" link on AQMD's home page at www.aqmd.gov.

PROGRAM GUIDELINES

Changes for 2003

The following changes have been made in the Carl Moyer Guidelines for 2003:

- Per CARB guidelines, only emissions reductions in excess of those required by the new EPA Tier II Diesel Emission Standards can be funded.

- The new CARB guidelines indicate that due to the variability of emissions among engines even in the same class, in-situ testing that follows the CARB testing protocol is encouraged. If in-situ testing is not performed, the default NOx factors must be used.

- The capital recovery factor has been reduced from 5% to 3%.

Project Eligibility Criteria

Eligible marine vessel projects include the differential cost for reduced-NOx emission new, repowered, or retrofitted diesel or alternative fuel engines. Vessels must operate within California Coastal Waters at least 75% of the time. Figure 3.1 is the map of California Coastal water boundaries as defined in the California Air Resource Board's

[1] Be sure to visit http://www.arb.ca.gov/msprog/moyer/moyer.htm for the latest approved CARB Moyer Program Guidelines.

Report to the California Legislature in 1984. This should be used by applicants to determine if their projects are eligible.

The following additional criteria must be met:

- Projects must result in surplus, real, quantifiable, and enforceable emission reductions over the life of the project.

- Thirty percent reduction in NOx emissions from uncontrolled baseline emissions for new engines.

- Fifteen percent reduction in NOx emissions from uncontrolled baseline emissions for repowers or retrofit engines.

- Applicants are required to submit detailed fuel receipts for the previous year[2] with their application documenting fuel consumption for each proposed project vessel in order for a project to be considered for funding under this program.

- Copies of fuel receipts, log books and any in-situ emission test data for a 12 month period should be submitted along with all applications.

- NOx reductions in the AQMD must be beyond what is required by any federal, local regulations, or other legally binding document.

- Projects will be evaluated for their ability to contribute toward AQMD's overall Moyer Program goal of 25 percent PM emission reduction.

- Project vessel may not apply for funding from the Carl Moyer Program if the same vessel is already receiving funds from another grant program (i.e., CARB's Emission Reduction Credit Bank for Peaking Powerplants Program, etc.). Nor may any vessels approved for, or in receipt of funding, from Moyer solicit additional project funds for the same vessel engines from other co-funding programs.

- NOx reductions must not result in increases in PM or HC emission relative to baseline levels.

- Replacement or retrofit engines must provide a 15 percent minimum NOx improvement relative to the baseline engine. A 30 percent reduction is required for new engine purchases. Certification emission factors are to be used for new replacement engines and in-situ source test data for replacement engines and the baseline engine (although the default values in Table 4.1 can be used. If the replacement engine is significantly modified or re-configured in anyway during its life, in-situ testing must be conducted to determine its new emission rates.

- Both main engines and auxiliary engines are eligible for funding.

[2] This period defined the most recent 12 month period.

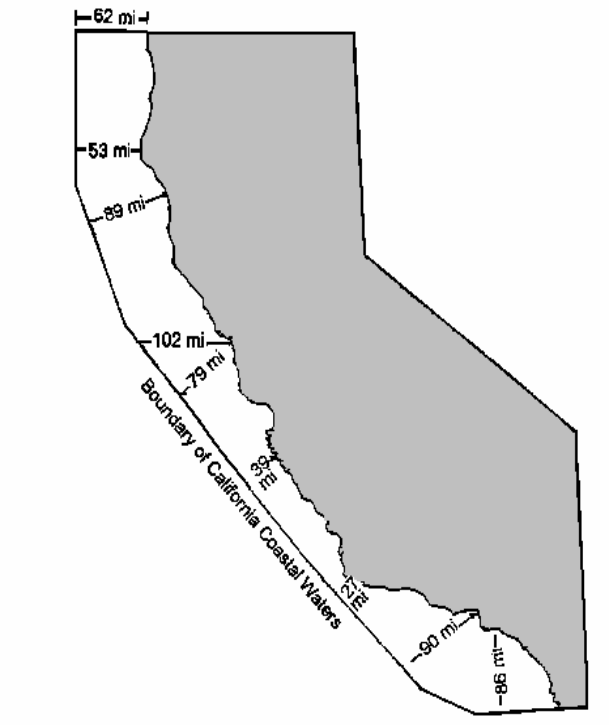
- Cost-effectiveness must be no more than $5,000 per ton of NOx reduced in AQMD Coastal waters.

- If the application is submitted by a specific representative, the application must include a letter from the vessel owner authorizing the representative to apply on his behalf.

- Reduced emission levels must be maintained for a minimum of 5 years or the life of the project, whichever is greater. New project life default values are provided in Table 4.2.

- Funded projects must operate for a minimum of five (5) years and at least 75 percent of nautical annual miles traveled must occur within AQMD coastal water boundaries (see map). Emissions reduction calculations are based on the percent of time a marine vessel operates within the district's emission inventory boundary.

Figure 3.1. Coastal water boundaries from the California Air Resources Board's Report to the California Legislature on Air Pollutant Emissions from Marine Vessels, 1984.



Evaluation Methodology

AQMD staff will evaluate all submitted proposals and make recommendations to the Governing Board for final selection of project(s) to be funded. Proposals will be evaluated based on the cost-effectiveness of NOx reduced on an equipment-by-equipment basis, as well as a project's "disproportionate impact" evaluation (discussed below). Be aware of the possibility that due to program priorities and/or funding

limitations, project applicants may be offered only partial funding, and not all proposals that meet minimum cost-effectiveness criteria may be funded.

In compliance with AB 1390, Firebaugh, the FY 2003 Moyer Program requires that at least 50 percent of the funds be spent in areas that are disproportionately impacted by air pollution. CARB has issued broad goals and left the details of how to implement this requirement to each air agency. In the South Coast Air Quality Management District, the disproportionately impacted areas are defined by a weighted formula that includes poverty level, particulate matter (PM) exposure and toxic exposure. The process is described below:

1. All projects must qualify for the Moyer Program by meeting the cost-effectiveness limits established in the RFP.

2. All projects will be evaluated according to the following criteria to qualify for Disproportionate Impact funding:

    a. Poverty Level: All projects in areas where at least 10 percent of the population falls below the Federal poverty level based on the year 2000 census data, will be eligible to be included in this category, and

    b. PM Exposure: All projects in areas with the highest 15 percent of PM concentration will be eligible to be ranked in this category. The highest 15 percent of PM concentration is 46 micrograms per cubic meter and above, on an annual average, or

    c. Toxic Exposure: All projects listed in the Multiple Air Toxics Exposure Study in the South Coast Air Basin (MATES II) report[3] as having a cancer risk of 1,000 in a million and above will be eligible to be ranked in this category.

    Data for the poverty level and PM and toxic exposures were obtained from the U.S. Census, the 1998 AQMD monitoring data and Mates II study respectively.

3. Fifty percent of the $12.3 million available for this RFP will be allocated among proposals located in disproportionately impacted areas. If the funding for disproportionately impacted areas is not exhausted with the outlined methodology, then staff will return to the Governing Board for direction. If funding requests exceed 50 percent of the total available funding, then all qualified projects will be ranked based on their disproportionate impact. Each project will be assigned a score that is comprised of 40 percent for poverty level, and 30 percent each for PM and toxic exposures. Proposals with the highest scores will receive funding until 50 percent of the total funding is allocated.

    All the proposals not awarded under the fifty percent disproportionate impact funding analysis will then be ranked according to cost-effectiveness, with the most cost-effective project funded first and then in descending order for each funding category until the remainder of the Moyer Funds are exhausted. Some

[3] Multiple Air Toxics Exposure Study in the South Coast Air Basin (MATES II), SCAQMD, March 2000.

projects that exceed the cost-effectiveness ceiling may receive partial funding, depending on their rankings.

Eligible Costs

Eligible costs for Moyer funding are limited to the incremental cost of rebuilding or overhauling a propulsion or auxiliary engine to a lower than required emissions standard as compared to the cost of a standard rebuild or overhaul of the existing engine. Engine, engine hardware and reasonable installation costs must be verified by bids. The bids should be included with the application. **A GPS system will be installed at no cost to the applicant.** The cost of the system will be added during the project evaluation period and does not need to be included in the application.

Payment Terms

Twenty percent of the funds will be withheld for marine vessel projects, to be remitted annually on a sliding scale. Upon receipt of the annual report, the twenty percent withhold will be decreased according to the following:

Year 1	15% withhold
Year 2	10% withhold
Year 3	7% withhold
Year 4	0% withhold

Reporting and Monitoring

During the project life, the AQMD has the authority to conduct periodic checks or solicit operating records from the applicant that has received Moyer funds for each retrofitted or repowered marine engine. This is to ensure that the engine is being operated as stated in the project application. The applicant must maintain operating records and have them available to the AQMD upon request. Records must contain, at minimum the following: marine vessel identification numbers; retrofit hardware model and serial numbers; nautical miles traveled in the AQMD and California coastal waters; estimated fuel consumption in AQMD coastal waters; estimated hours of operation in the California and AQMD coastal waters; and maintenance and repair dates (or any servicing information). Records must be retained and updated throughout the project life and made available for AQMD inspection.

Fuel Consumption Documentation

As emphasized earlier, applicants are required to submit with their application receipts for the most recent 12 months regarding fuel consumption of the project vessel(s). These fuel receipts should include the date of purchase and the number of gallons purchased. The total of the fuel receipts must match the fuel consumption listed on the project application.

PROJECT TYPES

Cost-effective projects will be those that include controls incorporated on vessels that frequent ports or remain in the harbor. These types of vessels include, but are not limited to, tugs, crew/supply boats, and fishing boats. Typical projects that would qualify for incentive funding under the CMP for marine vessels would include the use of retrofit kits or repowers to lower NOx emissions, or the purchase of new reduced-NOx marine engines. Natural gas engines are also eligible for CMP funding. Other projects, such as "cold ironing "may also be eligible. These types of projects will be evaluated on a case-by-case basis by the CARB and participating district. Projects where gasoline-fueled engines are replaced with new diesel engines or diesel engines are replaced with gasoline engines are not eligible for the CMP.

Projects consisting of new marine vessel engines that utilize reduced-NOx emissions would also be considered for funding. However, incremental costs for new engines may be too high to qualify this type of project as cost-effective. Please contact AQMD staff to discuss application for a "new" marine vessel project.

Projects consisting of reduced-NOx portside equipment such as Auxiliary Power Units or generators could also be considered for incentive funds. These types of projects would be less costly, compared to marine engine control. However, NOx emission reductions and cost-effectiveness would depend on the amount of operation hours from these types of equipment. The types of equipment, as well as the extent of operation, could vary considerably in each port. Hence, these types of projects would need to be evaluated individually to determine the project eligibility under the off-road guidelines. Applicants can chose to apply for main propulsion engines, auxiliary engines or both.

Engine Repowers

Repowering could occur during engine rebuild by exchanging a marine vessel's old engine for a newer, lower-emission engine. Funding eligibility will be evaluated based on the amount of emissions reduced and a maximum cost-effectiveness of $5,000 per ton. However, if the horsepower rating of the new engine exceeds that of the existing engine by 25 percent or more, the difference in the rating must be taken into account in the emission reduction calculation. An eligible repower project must provide a 15% minimum NOx improvement relative to the baseline engine.

Engine Retrofits

Retrofit involves hardware modifications to the engine, so the modified engine emits lower emissions. The conversion could occur by adding on control equipment to convert the engine to a reduced-NOx engine technology. Funding eligibility will be evaluated based on the amount of emissions reduced and a maximum cost-effectiveness of $5,000 per ton. However, if the horsepower rating of the new engine exceeds that of the existing engine by 25 percent or more, the difference in the rating must be taken into account in the emission reduction calculation. Furthermore, the cleaner engine would still need to test to an emission limit that is at least 15 percent lower than uncontrolled baseline NOx emissions.

New Engines

New marine engine purchases are eligible, but as indicated above may not be cost-effective. New engines must provide at least a 30% reduction over existing engine NOx levels.

Portside Equipment Repowers & Retrofits

Projects that consist of portside equipment engine repowers and retrofits could also qualify for incentive funds. Similar to marine vessel engine repowers and retrofits, these projects will be evaluated based on the amount of emissions reduced and a cost-effectiveness of at most $5,000 per ton. However, the cleaner engine would need to reduce NOx emissions to levels as described in the off-road equipment section of the Carl Moyer Program. In addition, the new certified emission level will have to be maintained for a minimum of 5 years (project life).

EMISSION REDUCTION AND COST-EFFECTIVENESS

Emission Standards and Factors

The number of engines used, their size, type, and power rating along with operational parameters, maintenance practices and the marinization process are all determinants of a marine vessel's NOx output. For the purpose of calculating NOx reductions, propulsion engine baseline emission factors should be based on in-situ test data wherever possible. Acceptable in-situ test cycles are discussed below. When in-situ testing is conducted in accordance with approved procedures, those results must be used when calculating NOx reductions. The maximum acceptable value of a baseline emission factor derived from in-situ source testing is 20 g/bhp-hr.

If in-situ testing is not feasible, the applicant can use the default baseline emission factors provided in Table 4.1 for propulsion engines. However, the emission factors in Table 4.1 apply to engines in the original engine manufacturer (OEM) configuration. If the engine has been modified to produce lower NOx emissions for any reason, these factors are not applicable. For engines modified from the OEM configuration, baseline emission factors must be based either on manufacturer's emissions data or in-situ source test data.

For auxiliary engines certification emission factors can serve as baseline emission rates.

Table 4.1 – Harbor Vessel NOx Emission Factors (g/bhp-hr)

Emissions Configuration	2 Stroke[a] Naturally-Aspirated	2 Stroke[a] Turbocharged	4 Stroke[b] Naturally-Aspirated	4 Stroke Turbocharged[b] Turbocharged/ aftercooled
Uncontrolled (Pre1980)	14[c]	11	8	7
Off-highway 1980	8	7	7	6

Notes:
a. 2 Stroke = Typically DDC -53 or –71 Series
b. 4 Stroke = Cat/Cummins and others
c. The 14 g/bhp-hr baseline is listed for EMD engines used in marine applications

The emission factors in Table 4.1 are currently being updated by CARB using actual in-situ test data from the districts. Ultimately, emission factors for marine engines will be developed and integrated into CARB's emission inventory models

Test Cycles for In-Situ Testing

A single emission test cycle or procedure can not appropriately capture the emission differences among various engine types and operating behavior. Recognizing this, the ISO has developed a number of test cycles that more accurately represent marine engine performance in a non-homogeneous fleet. CARB requires the following duty cycle/engine match for in-situ testing.

Constant speed propulsion engines are to be tested on the ISO 8178- E2 test cycle and constant speed auxiliary engines on the ISO 8178-D2 test cycle. Variable speed auxiliary engines and variable speed propulsion engines used with variable-pitch propellers (or electrically coupled propellers) will be tested on the ISO 8178-C1 duty cycle. All other Category 1 and 2 engines, including those used with fixed-pitch propellers, will be tested on the ISO 8178-E3 Marine Propeller Law Heavy Duty operating cycle.

There are several portable sampling systems on the market that can give accurate results. Engine speed can be monitored directly, but load may have to be determined indirectly. For constant speed engines, it is straightforward to set the engine to the points specified in the duty cycles. All engines should be tested using the diesel fuel type most commonly used in actual operation. The fuel type used by California commercial harbor craft -- marine distillate fuel (MDA) – is basically the same as on-road diesel. In fact, nearly all MDA is simply re-branded fuel originally manufactured for on-road use. Absent marine fuel standards, this will likely continue to be the case when new on-road diesel fuel standards go into effect in 2006. Refiners are not likely to develop a different fuel for the marine sector, which is roughly 6% of the diesel fuel market [U.S. EPA, 1999].

Because new commercial marine engines are likely to meet Tier 2 NOx standards without the use of sophisticated emission control devices (e.g., oxidation catalyst), the use of higher sulfur fuel will not likely have a significant impact on NOx emissions. For the same reason, CARB assumes (for the purpose of CMP funding) that the NOx emission differential between the existing engine and the replacement engine is maintained over the life of the replacement engine. We assume that maintenance practices generally do not change and that wear and deterioration of the new engine does not significantly increase NOx emissions relative to the replaced engine.

In lieu of using the emission factors in Table 4.1 or 4.3, baseline emissions may still be determined by using CARB approved in-situ source testing (Please contact AQMD staff for RFP #2001-42, which provides the most recent testing protocol). If source testing is performed, test results must be used even if testing indicates lower or higher emission factors than the default factors listed. The maximum acceptable value of a baseline emission factor derived from in-situ source testing is 20 g/bhp-hr.

Project Life

Table 4.2 provides the project life default value for each engine category.

Table – 4.2 Default Project Life for Marine Vessels

Category	Acceptable Life
Category 1 Engines	16 years
Category 2 Engines	23 years
Auxiliary Engines (Categories 1 or 2)	17 years

New Engine Standards

The U.S.EPA promulgated exhaust emission standards for new diesel engines over 37 kW (50 hp) on December 29, 1999 (64 FR 73301). The standards apply primarily to commercial harbor craft because the rule exempts recreational craft and the large "category 3" engines (over 30 liters per cylinder) used by most ocean-going vessels. There is a standard for PM, CO and a combined standard for NOx and ROG. As shown in Table 4.3 below, the specific standard and implementation date depends on the engine cylinder displacement. The NOx+THC standards range from 7.2 to 11 g/kW-hr. The implementation dates range from 2004 to 2007, depending on engine size.

Engines certified using a combined NOx+THC standard, it is assumed for the purpose of CMP project evaluations, that NOx will comprise 95% of the combined emissions. Table 4.3 shows the NOx only emissions calculation in the column immediately after the combined emissions.

Table 4.3 – U.S. EPA "Tier II" Marine Diesel Emission Standards

Engine Category	Displacement (liter/cyl)	Starting Date	NOx+THC (g/kW-hr)	NOx Only (at 95% of NOx + THC) g/kW-hr)
1	D < 0.9	2005	7.5	7.125
	0.9 ≤ D < 1.2	2004	7.2	6.84
	1.2 ≤ D < 2.5	2004	7.2	6.84
	2.5 ≤ D < 5.0	2007	7.2	6.84
2	5 ≤ D < 15	2007	7.8	7.41
	15 ≤ D < 20 (P < 3300 kW)	2007	8.7	8.27
	15 ≤ D < 20 (P ≥ 3300 kW)	2007	9.8	9.31
	20 ≤ D < 25	2007	9.8	9.31
	25 ≤ D < 30	2007	11.0	10.45

Auxiliary engines on marine vessels are subject to the harmonized CARB/U.S.EPA off-road CI engine standards for NOx. These standards and their implementation dates are listed in Table 4.4. The NOx only value is calculated using the following factors:

- Diesel engines: 0.95
- Alternative Fuel Engines: .80

Table 4.4 – CARB/US EPA Off-Road Compression Ignition Engine Standards for NOx

Maximum Rated Horsepower (hp)	Model Year	NOx	NOx+NMHC	NOx only—diesel	NOx only—alternative fuel
100≤hp<175	2000-2002	6.9			
	2003-2006	—	4.9	4.66	3.92
	2007 and later	—	3.0	2.85	2.4
175≤hp<300	2000-2002	6.9			
	2003-2005	—	4.9	4.655	3.92
	2006 and later	—	3.0	2.85	2.4
300≤hp<600	2000	6.9			
	2001-2005		4.8	4.56	3.84
	2006 and later		3.0	2.85	2.4
600≤hp≤750	2000-2001	6.9			
	2002-2005		4.8	4.56	3.84
	2006 and later		3.0	2.85	2.4
hp>750	2000-2005	6.9			
	2006 and later		4.8	4.56	3.84

As with propulsion engines, assume that NOx comprises 95% of the combined NOx+NMHC emissions when calculating NOx emissions for CMP evaluation.

Blue Sky Series Program

In order to provide engine manufacturers an incentive to produce engines that are cleaner than those required by regulations, the federal government developed the "Blue Sky Series Program."

The Blue Sky Series program permits manufacturers to certify their engines to more stringent emission standards than required. The qualifying emission limits are listed in Table 4.5. Marine engines that meet the Blue Sky Series standards are excellent candidates for participation in the CMP.

Table 4.5 – "Blue Sky Series" Voluntary Emission Standards

Cylinder Displacement (D, dm^3)	NOx+THC, g/kWh	NOx Only
Power ≥ 37 kW & D < 0.9	4.0	3.8
0.9 ≤ D < 1.2	4.0	3.8
1.2 ≤ D < 2.5	4.0	3.8
2.5 ≤ D < 5.0	5.0	4.75
5.0 ≤ D <15	5.0	4.75
15 ≤ D < 20 & Power < 3300 kW	5.2	4.94
15 ≤ D < 20 & Power < 3300 kW	5.9	5.6
20 ≤ D < 25	5.9	5.6
25 ≤ D < 30	6.6	6.27

Credit Generation Rules

On May 11, 2001, the South Coast District adopted four rules designed to generate NOx emission reduction credits for its Regional Clean Air Incentives Market (RECLAIM)

program. Two of these rules (Rules 1631 and 1632) apply to marine vessels. Rule 1631-- *Pilot Credit Generation Program for Marine Vessels* – allows for the generation of NOx credits through the voluntary replacement of harbor craft diesel engines with new cleaner engines. Several vessel owners have participated in the program. Rule 1631 was recently amended to allow for the inclusion of re-manufactured engines as well as new engines. Under Rule 1632 -- *Pilot Credit Generation Program for Hotelling Operations* -- NOx credits can be generated when vessels near ports use electrical power supplied by fuel cells. To date, credits have not been generated under Rule 1632. **Actions that receive NOx credits for these South Coast District programs are not eligible for CMP funding.**

Emission Reduction Calculation Discussion

Air quality benefits of new or retrofitted marine vessel engines are based on emission factors (EF). There are two methods of calculating emissions reductions—hours based and fuel based.

Hour-Based Emission Reduction Calculation

When calculating emission reductions, annual engine operating time is multiplied by the product of the brake specific NOx emission factor and the rated engine power for the new or newer replacement engine minus the product of the NOx emission factor and the rated engine power for the existing engine. Results are then converted to tons per year.

Annual NOx Reductions = Annual hours of operation * [(Baseline NOx EF * Baseline Rated Power) – (New NOx EF * New Rated Power)] * (tons/year) * ton/907200 g

Annual Hours of Operation = Estimated annual hours of engine operation for the existing engine to be replaced or altered (hours/year)

Baseline NOx EF = NOx emission factor for existing engine (g/bhp-hr)

New NOx EF = NOx emission factor of the replacement engine (new, rebuilt, or retrofit) (grams/bhp-hr)

Baseline Rated Power = Power rating of existing engine (hp)

New Rated Power = Power rating of the replacement engine (hp)

Conversion Factor = 907,200 grams/ton

Alternative Emission Calculation Method Using Fuel Consumption

In order to calculate the total annual emission output, the emission factors (those in Table 4.1 or obtained through in-situ testing) must be multiplied by the amount of time the engine is operated. Recognizing that not all vessel operators maintain records of engine operating time, we provide an alternative calculation method based on fuel consumption. If the annual hours of engine operation are not known but annual fuel consumption for the engine is known, the applicant can multiply the difference in

emission factors (old vs. new) by the appropriate fuel consumption factors listed in Table 4.6. The product is then multiplied by the number of gallons consumed annually to get the total annual emissions which is then converted to tons/year.

Table 4.6 – Fuel Consumption Rate Factors

Engine	Fuel Consumption Rate
Category 1	18.5 bhp-hr/gal
Category 2	20.8 bhp-hr/gal

For example, if a 1970 two-stroke category 1 naturally aspirated engine uses 20,000 gallons/year. This is being compared to a new engine that emits at a rate of 7 g/bhp-hr, the annual NOx emission reduction could be calculated as:

*20,000 gal/yr * (14.0 g/bhp-hr-7g/bhp-hr) * 18.5 bhp-hr/gal * ton/907,200 g = 2.85 tons/year*

Change in Horsepower from Existing Engine to New Engine

If the horsepower rating of the new engine differs from that of the existing engine by 25 percent, the difference in the rating must be taken into account in the emission reduction calculation. CARB is requiring districts to consider the difference by multiplying the estimated emissions from the new engine by a factor, as follows:

$$\text{Modified Emissions} = E_{new} * \frac{\text{Rating of new engine}}{\text{Rating of old engine}}$$

where, E_{new} = the emissions from the new engine.

Cost-Effectiveness Calculation Discussion

Project cost-effectiveness is based on the incremental capital cost, the expected life of the project, the interest rate, and the estimated annual NOx reductions. All calculations will use a three percent (3%) discount rate to create a capital recovery factor that reflects the opportunity cost of public funds for the CMP. Incremental costs are determined by taking the cost differential between the capital cost of the chosen project (e.g., the new engine or retrofit cost) and the cost of the alternative course of action (e.g., the replacement dirtier engine that was not purchased or the engine rebuilt that was foregone). Incremental costs are multiplied by the capital recovery factor and divided by the annual NOx reductions. This calculation will result in annualized project cost-effectiveness.

Table 4.7 provides the calculated capital recovery factors.

Table 4.7 Capital Recovery Factors (CRF) for Various Project Lives At 3 percent Discount Rate

Project Life	CRF
5	0.218
6	0.185
7	0.161
8	0.142
9	0.128
10	0.117
11	0.108
12	0.100
13	0.094
14	0.089
15	0.084
16	0.080
17	0.076
18	0.073
19	0.070
20	0.067

Project Incremental Capital Cost =
Chosen Project Capital Cost – Alternative Project Capital Cost

Chosen Project Capital Cost = capital costs of chosen project (e.g., new engine with low NOx emissions)

Alternative Project Capital Cost = costs of alternative action (e.g., a new engine with higher NOx emissions)

Capital Recovery Factor (provided in Table 4.6) = $[(1 + i)^n (i)]/[(1 + i)^n – 1]$

Where i = discount rate (3%)
n = project life

Annualized Cost = Incremental Project Capital Cost * Capital Recovery Factor

Cost-Effectiveness = **Annualized Cost / Annual NOx Reductions**

Example 1 – Propulsion Engine Purchase

Consider an owner faced with the opportunity to purchase a tugboat equipped with a Category 1 engine in the year 2004. The marine owner applies for funding to purchase the tugboat with a "Blue Sky" certified 800 hp diesel engine that costs $250,000. The Blue Sky engine has a certified NOx+THC emission factor of 5.0 g/bhp-hr. In lieu of purchasing this engine, the owner could purchase a 700 hp engine for $200,000 that just meets the Tier 2 NOx+THC standard of 7.2 g/bhp-hr. The owner operates the engine for 900 hours per year.

Emission Reduction Calculation

Baseline NOx EF (from Table 4.3)	**=6.84 g/bhp-hr (NOx = 95% of the 7.2 g/bhp-hr NOx+THC EF)**
New NOx EF (from Table 4.5)	**=4.75 g/bhp-hr (NOx = 95% of the 5.0 g/bhp-hr NOx+THC EF)**
Baseline Rated Power	**=700 hp**
New Rated Power	**=800 hp**
Annual Hours of Operation	**=900 hours**

Estimated NOx reductions are:
900 hours/yr * [(6.84 g/bhp-hr * 700 hp) – (4.75 g/bhp-hr * 800 hp)] * ton/907200 g = 0.98 tons/year

Cost Effectiveness Calculation

Chosen Project Capital Cost (Purchased Engine)	**$ 250,000**
Alternative Project Capital Cost (Engine not purchased)	**$ 200,000**
Project Life (Category 1 engine Table 4.2)	**16 years**
Incremental Project Cost:	**$ 250,000 - $ 200,000 = $50,000**
Capital Recovery Factor (Table 4.4):	**0.0796**
Annualized Cost:	**$ 50,000 * (0.0796) = $ 3,980/ year**
Cost Effectiveness:	**($ 3,980 / year) / (0.98 tons/year) = $3,901/ ton**

The cost of NOx reduction in this example is less than $5,000 per ton. Therefore, this project is eligible for CMP funds.

Example 2 – Tugboat Engine Replacement

Consider an owner faced with the opportunity to replace a tugboat engine during the normal engine overhaul period. In this case, the marine owner applies for funding to replace a 1,400 hp tugboat engine with a new 2,000 hp category 1 diesel engine. The new engine emits NOx at the rate of 6.8 g/bhp-hr. Based on in-situ testing, it was found that the old engine emits at a rate of 10.8 g/bhp-hr. The cost for rebuilding the old 1,400 hp engine is $100,000. The new engine is priced at $250,000. The marine vessel owner also documents that the annual fuel consumption for this tugboat in California would be approximately 90,000 gallons.

Emission Reduction Calculation

Annual Fuel Consumption:	**90,000 gals/year**
Energy Consumption Rate(Table 4.6)	**18.5 bhp-hr/gal**
Reduced NOx Emission Rate	**6.8 g/bhp-hr**

Existing NOx Emission Rate (in-situ test)	**10.8 g/bhp-hr**
Old Horsepower	**1400 hp**
New Horsepower	**2000 hp**

Estimated NOx reductions are:
90,000 gals/year * [(10.8 g/bhp-hr –6.8 g/bhp-hr)*(1400/2000)]* 18.5 bhp-hr/gal * ton/907,200 g = **5.14 tons/year**

Cost Effectiveness Calculation

Rebuild cost	**$100,00**
Capital cost of new engine	**$250,000**
Project life (Table 4.2)	**16 years**
Incremental Project Cost:	**$ 250,000 - $ 100,000 = $150,000**
Capital Recovery Factor (Table 4.7):	**0.0796**
Annualized Cost:	**($150,000) * (0.0796) = $11,940 / year**
Cost Effectiveness:	**($11,940/ year) / (5.14tons/year) = $2,323/ton**

The cost benefit for the example is less than $5,000 per ton of NOx reduced. This project qualifies for grant funds.

Example 3 – Auxiliary Engine Repower

Consider this same owner also wants to replace one auxiliary engine rated at 92 hp that operates 900 hours/year. The existing engine emits at a rate of 8.0 g/bhp-hr. The new engine is also rated at 92 hp, but has an NOx + NMHC emission rate of 4.9 g/bhp-hr. The capital cost for rebuilding the auxiliary engine is $2,000 and the replacement engine costs $15,000, based on supporting documentation.

Emission Reduction

Baseline NOx EF (in-situ test)	8.0 g/bhp-hr
New NOx EF (Table 4.4)	4.66 g/bhp-hr (NOx = 95% of the 4.9 g/bhp-hr NMHC+NOx EF)
Baseline Rated Power	92 hp
New Rated Power	92 hp
Annual Hours of Operation	900 hours

Estimated NOx reductions are:
900 hours/yr * [(8.0 g/bhp-hr * 92hp) – (4.66 g/bhp-hr * 92 hp)] * ton/ 907200 g = **0.30 tons/year**

Cost Effectiveness Calculation

Incremental Project Cost:	$ 15,000 - $ 2,000 = $ 13,000
Project Life (Table 4.2)	17 years
Capital Recovery Factor (Table 4.7):	0.076
Annualized Cost:	$ 13,000 * 0.076 = $ 987/ year
Cost Effectiveness:	($ 987 / year) / (0.30 tons/year)= **$296/ton**

The cost benefit for the example is less than $5,000 per ton of NOx reduced. This project qualifies for grant funds.

Carl Moyer Memorial Air Standards Attainment Program
MARINE VESSEL PROJECT
APPLICATION

Please provide all information requested regarding your proposed purchase and application. Additional information may be requested during the review process. Applicant acknowledges that award of cash incentive is subject to AQMD approval and must meet the minimum eligibility criteria within the project category.

A. APPLICANT INFORMATION: Please Print or Type All Information.

Organization Submitting Application:		
Application Contact Name and Phone Number:		
Vessel Name:		
Vessel Owner Name (person with contract signing authority):		
Vessel Owner Street/mailing address:		
City:	State:	Zip code:
Phone: ( )	Fax: ( )	
E-mail:		
Geographic area served by organization (i.e., project location):		
Geographic area to be served by marine vessel (if different than above):		
Number of marine vessels in fleet:		

I hereby certify that all information provided in this application/attachments are true and correct.

Number and Type of Vessel(s) Requested for Funding:	Total Funding Request:
Printed Name of Vessel Owner:	Title:
Signature of Vessel Owner:	Date:

CHECK LIST FOR APPLICATION ITEMS

Be sure the following items are included with your application submittal. Check each applicable box below to indicate inclusion of material.

- ❑ Completed Application (All Sections).
- ❑ Checklists for Application Items and Eligibility Criteria.
- ❑ Vendor quotes or other documentation substantiating cost data provided in Application.
- ❑ Fuel receipts and operating records for the past 12 months (Important note: your application will be rejected if this information is not provided).
- ❑ Existing engine baseline emission certification/verification data/documentation.
- ❑ Contracting Statements
  - ❑ Statement of Understanding for Work Statement and Deliverables
  - ❑ Conflict of Interest Statement (as described in the RFP)
  - ❑ Third-Party Application Submittal Authorization (Only required if application is submitted by someone other than the vehicle/equipment owner.)
- ❑ Letter of Agreement from Fuel Provider (if alternative fuel project)
- ❑ Co-funding information attachments to Section E (if applicable)
- ❑ Certifications and Representations
- ❑ Other (attach explanation)

If you have any questions regarding the application process for Marine Vessels, please contact Connie Day, Science & Technology Advancement at (909) 396-3055 by phone, or (909) 396-3252 by fax..

REMINDER

Due Date - The proposer shall submit **six (6) complete copies of the proposal** in a sealed envelope, plainly marked in the upper left-hand corner with the name and address of the proposer and the words "Request for Proposals #2004-04." All proposals are due no later than 5:00 p.m., on Friday, October 10, 2003. Postmarks are not accepted. **Faxed or e-mailed proposals will not be accepted**. Proposals must be directed to:

Procurement Unit
South Coast Air Quality Management District
21865 East Copley Drive
Diamond Bar, CA 91765

CONTRACTING STATEMENTS (ALL ARE REQUIRED)

1. Statement of Understanding for Work Statement and Deliverables

In order to minimize the effort required to complete a Moyer Program Application, AQMD does not require submittal of a Work Statement or Deliverables Summary with the Application. However, the undersigned confirms full understanding that, if awarded funding under the Carl Moyer Program, development and submittal of the detailed work statement, with deliverables and schedule, is a requirement of the contracting process. Recommended projects will not receive funding without these documents. Full details of the Work Statement and Deliverables requirements are detailed in RFP #P2002-22. In addition, Baseline and LEV vehicle Serial/VIN information must be provided at contract start. By signing below, the applicant acknowledges these requirements.

2. Conflict of Interest Statement

Please address any potential conflicts of interest with other clients affected by actions performed by the firm on behalf of the AQMD in the form of a Conflict of Interest Statement. Although the proposer will not be automatically disqualified by reason of work performed for such firms, the AQMD reserves the right to consider the nature and extent of such work in evaluating the proposal. Conflicts of interest will be screened on a case-by-case basis by the AQMD District Counsel's Office. Conflict of interest provisions of the state law, including the Political Reform Act, may apply to work performed pursuant to this contract. Please provide a Conflict of Interest Statement below. If additional room is necessary, please attach extra pages to this sheet.

3. Third-Party Application (Circle One: Applicable Not Applicable)

Applicants who are submitting on behalf of a marine vessel owner must provide authorization from the marine vessel owner to act on their behalf for this application process. This authorization shall be provided in the form of a "Letter of Exclusive Authorization", to be attached to this sheet. In addition, the marine vessel owner shall enter into a contract with its authorized applicant, who will sign a contract with AQMD for fulfilling all contract obligations.

Applicant Name and Phone:	Applicant Organization:
Printed Name of Vessel Owner:	
Signature of Vessel Owner:	Date:

CHECK LIST FOR ELIGIBILITY CRITERIA

Please check each applicable box to indicate eligibility of proposed marine vessel engine technology.

- ❑ The existing marine vessel is used as an auto carrier.
- ❑ The existing marine vessel is used as a bulk carrier.
- ❑ The existing marine vessel is used as a container ship.
- ❑ The existing marine vessel is used as general cargo.
- ❑ The existing marine vessel is used as a passenger ship.
- ❑ The existing marine vessel is used as a reefer.
- ❑ The existing marine vessel is used as a RORO.
- ❑ The existing marine vessel is used as a tanker.
- ❑ The existing marine vessel is used as tug/tow/push boat.
- ❑ The existing marine vessel is used as a work/supply/utility boat.
- ❑ The existing marine vessel is used as a fishing vessel.
- ❑ The existing marine vessel is used as a U. S. Navy ship.
- ❑ The proposed engine technology is eligible for program funding.

Check applicable categories below:

The reduced-emission engine/technology:

- ❑ has been tested, or
- ❑ is under experimental permit for operation in California,

and

For retrofit kits or add-on equipment projects:

- ❑ shows at least a 15 percent reduction of NOx emissions and no significant increase in particulate emissions compared to the applicable United States Environmental Protection Agency's (USEPA) standard for that engine year and type of application through:
  - ❑ California Air Resources Board (CARB) testing,
  - ❑ U.S. EPA testing, or
  - ❑ Emission testing at a laboratory approved by the U.S. EPA or the CARB.
- ❑ The retrofit technology is warranted by retrofit manufacturer.
- ❑ The purchase is not required by any local, state, federal or international maritime rule, regulation, or binding agreement.
- ❑ The amount of emission reduction is not required by any local, state, federal, or international maritime rule, regulation, or binding agreement.

MARINE VESSEL REPOWER/RETROFIT APPLICATION SECTION

Please check one:

- ❑ Repowering a marine vessel with a new low-emission engine (replacement)
- ❑ Retrofitting a marine vessel engine with new low-emission technology

B. GENERAL INFORMATION ABOUT EACH ENGINE FOR REPOWER OR RETROFIT	
1. Vessel Name:	
2. Number of engines to be purchased/retrofitted/repowered for this vessel:	
3. Dead weight tonnage (DWT):	
4. Type of engines: Primary: APU:	
5. Fuel type for each engine (if applicable):	
6. Primary function of each marine vessel:	
7. Propulsion type (motorship, or steamship):	
8. Annual number of port calls in a port:	9. Annual number of port calls in a California:
10. Estimated total annual hours of operation per port call in each service mode: a. Cruise: b. P-Zone Cruise: c. Maneuvering: d. Hotelling:	11. Average ship service speed in each service mode: a. Cruise: b. P-zone cruise: c. Maneuvering: d. Hotelling
12. Average fuel consumption/rate (gallons or gallons/hour) per port call for each service mode: a. Cruise: b. P-Zone Cruise: c. Maneuvering: d. Hotelling:	13. Average fuel consumption (gallons) per port call for auxiliary power (if applicable): a. Boilers (motorship): b. Engines (motorship): c. Main boilers (steamship):
14a. Estimated total annual nautical miles in California coastal water boundary:	14b. Percent within AQMD boundaries:
15. Estimated annual fuel consumption (in gallons) for each marine vessel:	16. Incentive Amount Requested:
17. Estimated Project Life:	
18. Is there any seasonality to the use of the marine vessel? YES/NO If Yes, please explain:	

MARINE VESSEL REPOWER/RETROFIT APPLICATION SECTION (continued)

CURRENT MARINE VESSEL/ENGINE (BASELINE)	NEW REDUCED EMISSION ENGINE/RETROFIT
19. Baseline Model year:	Model year:
20. Baseline Engine make:	Engine make:
21. Baseline Engine model number:	Engine model number:
22. Serial number of Baseline engine:	Serial number of cleaner engine: (to be provided when available)
23. Baseline Horsepower:	Horsepower:
24. Baseline Average engine life (yrs):	Average engine life (yrs):
25. Typical rebuild/replacement schedule for Baseline:	Typical rebuild/replacement schedule:
26. Cost of replacing/rebuilding engine w/out control: $	Cost of replacing/rebuilding engine with control: $
27. NOx emission level w/out control (lbs/1000 gals):	NOx emission level with control (lbs/1000 gals):
28. PM emission level w/out control (lbs/1000 gals):	PM emission level with control (lbs/1000 gals):

C. GENERAL INFORMATION ABOUT THE INSTALLER

MARINE VESSEL ENGINE FOR REPOWER (replacement)	
Engine installer:	
Street address:	
City:	State:
Phone: ( )	Fax: ( )
Contact name:	

OR

RETROFIT TECHNOLOGY	
Retrofit manufacturer:	
Retrofit Installer:	
Installer street address:	
City:	State:
Phone: ( )	Fax: ( )
Contact name:	Retrofit kit number:
Description of retrofit technology:	

Remember: Vendor quotes are required to be submitted with this application!

E. OTHER INFORMATION

1. MAINTENANCE

Describe your maintenance facility and practices, including any training regarding the low-emission technology. If the training has not been completed, provide a time line for completion.

2. CO-FUNDING INFORMATION

Describe your funding sources for this project. At a minimum, this will include your company or agency's own budget for this project. For example, you could show the amount of funding you budgeted for the non-LEV portion of the vehicle/equipment.

3. BUSINESS TYPE AND ALTERNATIVE FUEL STATION ACCESS

Please provide a brief description of your business and your fleet. If you are proposing to purchaser alternative fuel technology, how will this be integrated into your fleet. If you are installing alternative fuel technology, attach written verification of access to refueling facility.